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Special Flood Hazard Evaluation Report

French Creek, Mills Creek, and Robinson Ditch, City of North Ridgeville, Lorain County, Ohio

Prepared for the
Ohio Department of Natural Resources

US Army Corps
of Engineers
Buffalo District

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This report represents the Corps' views on potential flooding of drainage areas near French Creek, Hills Creek and Robinson Ditch within the city of North Ridgeville, Ohio. This report identifies the 100-year and 500-year flood plains and 100-year floodway for French Creek and Hills Creek upstream of Center Ridge Road and for Robinson Ditch between Hills Creek and French Creek.

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SPECIAL FLOOD HAZARD EVALUATION REPORT
FRENCH CREEK, MILLS CREEK, AND ROBINSON DITCH
CITY OF NORTH RIDGEVILLE
LORAIN COUNTY, OHIO

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INTRODUCTION

This Special Flood Hazard Evaluation Report documents the results of an investigation to determine the potential flood situation along French Creek, Mills Creek and Robinson Ditch within the city of North Ridgeville, Ohio. This study was conducted at the request of the Ohio Department of Natural Resources under the authority of Section 206 of the 1960 Flood Control Act, as amended. The study reaches include French Creek, from Center Ridge Road upstream to its confluence with Robinson Ditch; Robinson Ditch, between Mills Creek and French Creek; and Mills Creek, from the confluence with Robinson Ditch upstream to the eastern corporate limit. Mills Creek and Robinson Ditch are tributaries to French Creek.

The city of North Ridgeville is located in northern Ohio in northeastern Lorain County. The city is approximately 18 miles west of Cleveland, Ohio and 6 miles east of Elyria, Ohio. It is bordered on the north by the city of Avon, on the east by unincorporated areas of Cuyahoga County, on the south by unincorporated areas of Lorain County, and on the west by the city of Elyria. The 1990 population of North Ridgeville was reported to be 21,564 (Reference 1).

The climate of North Ridgeville is classified as continental, characterized by moderate extremes of temperature and precipitation. Winds off Lake Erie tend to lower summer temperatures and raise winter temperatures. Average annual precipitation is 34.99. The maximum temperature recorded at nearby Cleveland Airport was 103 degrees Fahrenheit (°F), recorded in July 1941; a minimum of -19°F was recorded in January 1963. The maximum 24-hour rainfall was 4 inches, recorded in June 1972, and the maximum 24-hour snowfall was 15 inches, recorded in November 1950 (Reference 2).

French Creek originates in Cuyahoga County and flows in a westerly direction to North Ridgeville, then northerly through North Ridgeville and the city of Avon and easterly to the Black River. Mills Creek originates in Cuyahoga County and flows in a northwesterly direction through North Ridgeville to the city of Avon and its confluence with French Creek. Robinson Ditch originates in North Ridgeville and flows in a northwesterly direction draining an area between Mills Creek and French Creek. It then parallels Center Ridge Road flowing both westerly to French Creek and easterly to Mills Creek. The streams are ungaged.

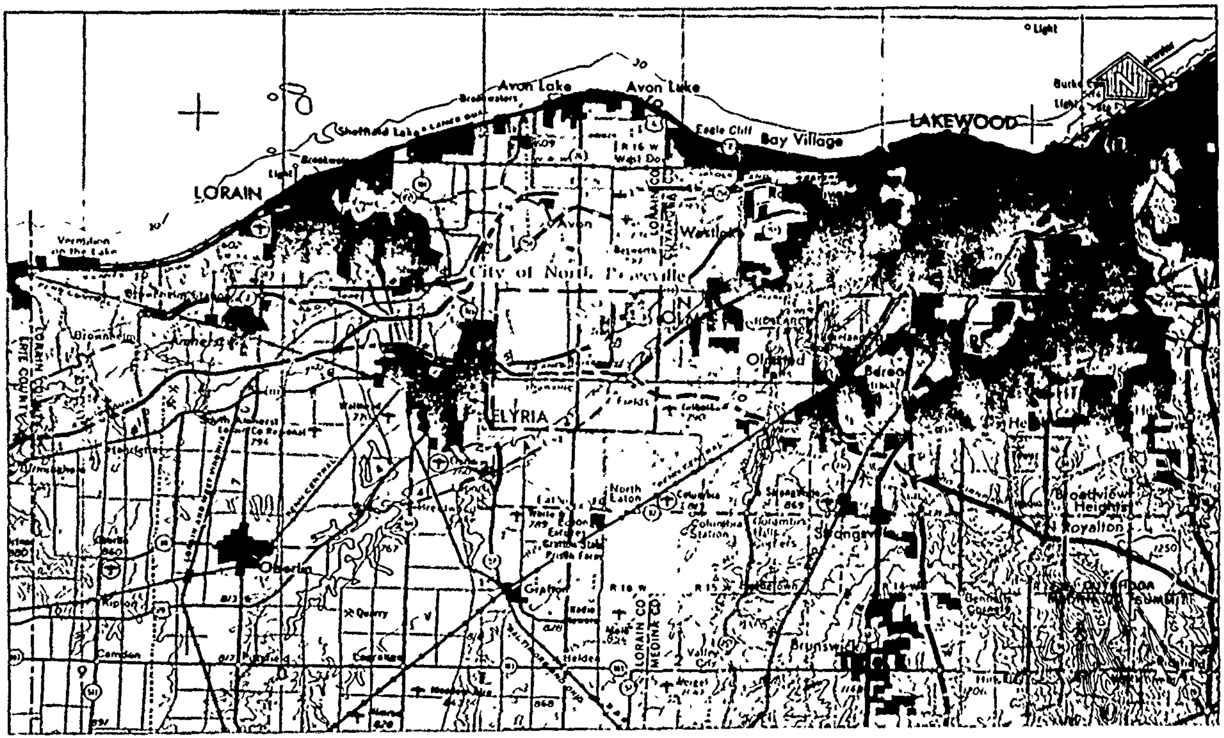

FIGURE 1

CITY OF NORTH RIDGEVILLE, OHIO
(LORAIN CO.)

VICINITY MAP

The topography of North Ridgeville ranges from nearly level to sloping, with elevations in the study area from 750 to 700 feet.

Knowledge of potential floods and flood hazards is important in land use planning. This report identifies the 100-year and 500-year flood plains and 100-year floodway for French Creek and Mills Creek upstream of Center Ridge Road and for Robinson Ditch between Mills Creek and French Creek.

Information developed for this study will be used by local officials to manage future flood plain development. While the report does not provide solutions to flood problems, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development, thereby preventing intensification of the flood loss problem. It will also aid in the development of other flood damage reduction techniques to modify flooding and reduce flood damages which might be embodied in an overall Flood Plain Management (FPM) program. Other types of studies, such as those of environmental attributes and the current and future land use roles of the flood plain as part of its surroundings, would also profit from this information.

Although Flood Insurance Rate Maps have been previously developed for the community, detailed analyses was not used to study the stream reaches analyzed in this study. Local officials require the detailed flood plain information to manage residential development.

Additional copies of this report can be obtained from the Ohio Department of Natural Resources until its supply is exhausted, and the National Technical Information Service of the U.S. Department of Commerce, Springfield, Virginia 22161, at the cost of reproducing the report. The Buffalo District Corps of Engineers will provide technical assistance and guidance to planning agencies in the interpretation and use of the hydrologic data obtained for this study.

PRINCIPAL FLOOD PROBLEMS

Most flooding in Ohio is caused by rainfall of unusual intensity and duration. General flooding occurs most frequently during January to March and occasionally during August to October.

Principal flood problems in North Ridgeville have been in areas where urbanization has occurred in the flood plain. Undersized bridges and culverts lead to stream flow backups, and these conditions extend long distances upstream due to the small stream gradients. However, as the streams are ungaged, there are no stream flow records and no accurate record of floods within the city of North Ridgeville.

Flood Magnitudes and Their Frequencies

Floods are classified on the basis of their frequency or recurrence interval. A 100-year flood is an event with a magnitude that can be expected to be equaled or exceeded once on the average during any 100-year period. It has a 1.0 percent chance of occurring in any given year. It is important to note that, while on a long-term basis the exceedence averages out to once per 100 years, floods of this magnitude can occur in any given year or even in consecutive years and within any given time interval. For example, there is a greater than 50 percent probability that a 100-year event will occur during a 70-year lifetime. Additionally, a house which is built within the 100-year flood level has about a one-in-four chance of being flooded in a 30-year mortgage life.

Hazards and Damages of Large Floods

The extent of damage caused by any flood depends on the topography of the flooded area, the depth and duration of flooding, the velocity of flow, the rate of rise in water surface elevation, and development of the flood plain. Deep water flowing at a high velocity and carrying floating debris would create conditions hazardous to persons and vehicles which attempt to cross the flood plain. Generally, water 3 or more feet deep which flows at a velocity of 3 or more feet per second could easily sweep an adult off his feet and create definite danger of injury or drowning. As indicated in Table 2, flow velocities of the streams studied exceed 3 feet per second at some locations on both Mills Creek and French Creek. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed or in vehicles that are ultimately submerged or floated. Since water lines can be ruptured by deposits of debris and by the force of flood waters, there is the possibility of contaminated domestic water supplies. Damaged sanitary sewer lines and sewage treatment plants could result in the pollution of floodwaters and could create health hazards. Isolation of areas by floodwater could create hazards in terms of medical, fire, or law enforcement emergencies.

HYDROLOGIC ANALYSES

Hydrologic analyses were carried out to determine the peak discharge-frequency relationships for each flooding source affecting the community.

Depending on the stream, one of two methodologies was used. For French Creek, the regional equations for the United States Geological Survey's (USGS) Water Resources Investigations Report 89-4126 was used (Reference 3). For Mills Creek and Robinson Ditch, the Graphical Peak Discharge Method of the Soil Conservation Services TR-55 was used (Reference 4).

FRENCH CREEK:

For French Creek, one hydrologic reach, from Center Ridge Road to the confluence with Robinson Ditch, was delineated.

The regional discharge-frequency equations of WRI 89-4126 calculate peak discharges for frequencies of 50, 20, 10, 4, 2, and 1 percent. The peak discharges calculated using WRI 89-4126 were plotted and extrapolated to determine the 500-year (frequency of 0.2%) annual peak discharge. Since WRI 89-4126 develops discharge-frequency relationships that are applicable to rural, unregulated streams, and since most of French Creek is developed, the annual peak discharges calculated using WRI 89-4126 were adjusted to account for urbanization.

The drainage area, main channel stream slope, time of concentration (Tc), the runoff curve number (Cn), and the percentage of the watershed covered with wetlands or ponds were calculated for the selected location on French Creek. The peak 100-and 500-year discharges at this point, were calculated using WRI 89-4126 and are shown in Table 1 - Summary of Discharges.

MILLS CREEK:

Three hydrologic reaches were delineated for Mills Creek.

Reach 1 extends from just upstream of Robinson Ditch to just downstream of Boulder Road;

Reach 2 extends from the upstream limit of Reach 1 to just downstream of the unnamed tributary near Chestnut Ridge Road;

Reach 3 extends from just downstream of the unnamed tributary near Chestnut Ridge Road to Lorain Road.

The drainage areas, main channel slopes, time of concentration (Tc), the runoff curve number (Cn), and the percentage of the watershed covered with wetlands or ponds were developed for selected points on Mills Creek. The peak discharges were calculated at these points using the guidelines of TR-55 and are shown in Table 1 - Summary of Discharges.

ROBINSON DITCH:

Three hydrologic reaches were delineated for Robinson Ditch.

Reach 1 is from the confluence with French Creek east to that portion of the ditch that runs south to north;

Reach 2 is from the upstream limit of Reach 1 to Debbie Court (Ditch flows east to west); and

Reach 3 is from just upstream of its confluence with Mills Creek to Debbie Court (ditch flows west to east.)

Robinson Ditch crosses the basin divide between the Mills Creek and French Creek watersheds. Debbie Court was assumed to be the

divide for the ditch in determining which way the water flows in the ditch. The drainage areas, main channel slopes, time of concentration (Tc), the runoff curve number (Cn), and the percentage of the watershed covered with wetlands or ponds were developed for selected points on Robinson Ditch. The peak discharges at these points were calculated using the guidelines of TR-55 and are also contained in Table 1 - Summary of Discharges.

The TR-55 method was selected for Mills Creek and Robinson Ditch because of the size of the watersheds. Smaller watersheds are better represented by the TR-55 modeling process and urbanization is already factored in.

Watershed characteristics were determined through use of USGS 7.5-minute topographic maps (Reference 5) and the guidelines in the National Handbook of Recommended Methods for Water Data Acquisition (Reference 6). The values for the drainage areas and 100-year peak discharges are shown in Table 1.

Table 1 - Summary of Discharges

Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)	
		100-Yr	500-Yr
French Creek			
Just upstream of an unnamed tributary	6.14	1080	1280
Mills Creek			
Just upstream of Robinson Ditch	1.97	670	820
Just downstream of an unnamed tributary near Chestnut Ridge Road	1.67	600	730
Just upstream of an unnamed tributary near Chestnut Ridge Road	1.56	560	680
Robinson Ditch			
at confluence with French Creek	1.10	390	490
at point where ditch starts to flow east to west	.70	340	410
at confluence with Mills Creek	.45	190	230

HYDRAULIC ANALYSES

Analyses of the hydraulic characteristics of flooding from sources studied were carried out to provide estimates of the elevations of floods for the 100-year and 500-year recurrence intervals.

Cross-section data for the backwater analyses were obtained from field surveys performed by City of North Ridgeville personnel. Additional elevation data were obtained from USGS topographic maps (Reference 5). Bridges and culverts were surveyed to determine elevation data and structural geometry. Spot elevations were obtained in the overbank areas in order to accurately delineate the flood plain boundaries.

Water surface elevations of the 100-year and 500-year recurrence interval were computed using the COE HEC-2 step-backwater computer program (Reference 7). Starting water surface elevations for French Creek and Mills Creek were established by the Corps of Engineers while conducting a Limited Map Maintenance Program Study in the City of North Ridgeville. The LMMP was completed in September 1991. The starting water surface elevation for the tributary, Robinson Ditch West, was determined using 950 cfs and 1150 cfs on the main stem which are the coincidental discharges on French Creek when the 100-year and 500-year peaks of 390 cfs and 490 cfs occur on the tributary, according to coincidental frequency analyses. The starting water surface elevation for the tributary, Robinson Ditch East, was determined using 680 cfs and 840 cfs on the main stem which are the coincidental discharges on Mills Creek when the 100-year and 500-year peaks of 190 cfs and 230 cfs occur on the tributary. The use of coincident discharges methodology was due to the close proximity of the watersheds of all streams involved. The tailwater effect from the 100-year and 500-year discharges on the main streams was plotted on the Flood Profiles. The flooded outline for Robinson Ditch was plotted based on the tailwater effect from French Creek to the Lear Nagle Road bridge. East of Lear Nagle Road, the Robinson Ditch water flows downward and remains within the 100-year and 500-year flood boundaries. The flooded outline on Robinson Ditch, east of Lear Nagle Road, was plotted based on the stage from Mills Creek due to overland flow.

One profile was plotted for Robinson Ditch although the stream was modeled as two separate backwaters. It was determined that water flows in both directions on this creek under low flow conditions, and the hydrologic assumption was that the divide occurred at the Debbie Drive culvert. However, under high flows, it appears the divide on Robinson Ditch would actually occur near the tributary that runs north and south just west of Pitts Road. The Flood Profile for Robinson Ditch shows the backwater effect from the main stem of French Creek and the flood level from Mills Creek.

Locations of the selected cross-sections used in the hydraulic analyses are shown on the Flood Profiles (Plates 1, 2, and 3) and on the Flooded Area Maps (Plates 4 and 5).

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were selected using engineering judgement and were based on field observations of the stream and flood plain areas. The "n" values ranged from 0.013 to 0.045 in the channel. An overbank "n" value of 0.07 was used; however, at times a high overbank "n" value of 1.0 was used to eliminate flows from non-effective flow areas. Contraction and expansion coefficients used in the backwater varied from 0.1 to 0.3 and 0.3 to 0.5, respectively.

Flood profiles were drawn showing the computed water surface elevations for the selected recurrence intervals. The flood plain boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using USGS topographic maps and spot elevations obtained during the field surveys. Small areas within the flood plain boundaries may be above the flood elevations, but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

An encroachment floodway was determined for French Creek, Mills Creek, and a portion of Robinson Ditch West (from the confluence of French Creek to the tributary that runs north and south just west of Pitts Road). No floodway was determined on Robinson Ditch East and the remaining portion of Robinson Ditch West because the drainage areas for these reaches are less than one square mile. Floodway encroachments were based on equal conveyance reduction from each side of the flood plain, with adjustments as necessary to account for the effects of existing development and to provide functional and manageable floodways. At the request of the Ohio Department of Natural Resources, the maximum increase in stage due to encroachment was limited to 1 foot provided that hazardous velocities were not produced. Floodway widths were computed at cross sections and varied from 17 to 216 feet. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections and are shown in Table 2. The computed floodway is also shown on the Flooded Area Maps, Plates 4 and 5. In cases where the floodway and the 100-year flood plain boundaries are either close together or collinear, only the floodway boundary is shown.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profile are considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Descriptions of the marks are presented in Table 3.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
FRENCH CREEK								
A	67,746	48	245	4.4	726.1	726.1	726.1	0.0
B	68,500	68	452	2.4	726.8	726.8	727.1	0.3
C	69,394	65	320	3.4	727.2	727.2	727.9	0.7
D	70,000	80	439	2.5	728.3	728.3	729.2	0.9

1/ Distance is measured in feet from confluence with Black River.

TABLE 2

CITY OF NORTH RIDGEVILLE, OHIO
LORAIN COUNTY

FLOODWAY DATA

FRENCH CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
MILLS CREEK								
A	17,160	121	627	1.4	725.8	725.8	726.5	0.7
B	18,105	36	175	3.8	729.0	729.0	729.3	0.3
C	19,334	39	169	3.5	734.8	734.8	735.2	0.4
D	20,890	24	93	6.4	745.3	745.3	745.9	0.6
E	22,200	20	84	7.2	749.8	749.8	750.7	0.9
F	23,300	65	215	2.6	754.8	754.8	755.8	1.0
G	24,950	23	104	5.4	760.0	760.0	760.9	0.9

1/ Distance is measured in feet from confluence with French Creek.

TABLE 2

CITY OF NORTH RIDGEVILLE, OHIO
LORAIN COUNTY

FLOODWAY DATA

MILLS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
ROBINSON DITCH								
A	0	80	379	2.5	728.3	727.7 2/	728.4	0.7
B	500	17	161	2.4	728.3	727.8 2/	728.7	0.9
C	1,480	207	869	0.4	728.3	728.0 2/	729.0	1.0
D	2,500	215	885	0.1	728.3	728.0 2/	729.0	1.0

1/ Distance is measured in feet from confluence with French Creek.

2/ Elevations computed without consideration of backwater effect from French Creek.

TABLE 2

CITY OF NORTH RIDGEVILLE, OHIO
LORAIN COUNTY

FLOODWAY DATA

ROBINSON DITCH

Table 3 - Elevation Reference Marks

Reference Mark	Elevation (feet NGVD)	Description of Location
RM1	733.34	Top of fire hydrant located on northwest corner of Washington Street and Lear Nagle Road intersection.
RM2	733.65	Top of fire hydrant located at northwest corner of Center Ridge Road and State Route 83 intersection.
RM3	758.39	Top of fire hydrant located at northwest corner of Lear Nagle Road and Chestnut Ridge Road intersection.
RM4	732.40	Top of fire hydrant on west side of Root Road, opposite residence #7068 Root Road.

UNIFIED FLOOD PLAIN MANAGEMENT

Historically, the alleviation of flood damage has been accomplished almost exclusively by the construction of protective works such as reservoirs, channel improvements, and floodwalls and levees. However, in spite of the billions of dollars that have already been spent for construction of well-designed and efficient flood control works, annual flood damages continue to increase because the number of persons and structures occupying floodprone lands is increasing faster than protective works can be provided.

Recognition of this trend has forced a reassessment of the flood control concept and resulted in the broadened concept of unified flood plain management programs. Legislative and administrative policies frequently cite two approaches: structural and nonstructural, for adjusting to the flood hazard. In this context, "structural" is usually intended to mean adjustments that modify the behavior of floodwaters through the use of measures such as dams and channel work. "Nonstructural" is usually intended to include all other adjustments in the way society acts when occupying or modifying a flood plain (e.g., regulations, floodproofing, insurance, etc.). Both structural and nonstructural tools are used for achieving desired future flood plain conditions. There are three basic strategies which may be applied individually or in combination: (1) modifying the susceptibility to flood damage and disruption, (2) modifying the floods themselves, and (3) modifying (reducing) the adverse impacts of floods on the individual and the community.

Modify Susceptibility to Flood Damage and Disruption

The strategy to modify susceptibility to flood damage and disruption consists of actions to avoid dangerous, economically undesirable, or unwise use of the flood plain. Responsibility for implementing such actions rests largely with the non-Federal sector and primarily at the local level of government.

These actions include restrictions in the mode and the time of occupancy; in the ways and means of access; in the pattern, density, and elevation of structures and in the character of their materials (structural strength, absorptiveness, solubility, corrodibility); in the shape and type of buildings and in their contents; and in the appurtenant facilities and landscaping of the grounds. The strategy may also necessitate changes in the interdependencies between flood plains and surrounding areas not subject to flooding, especially interdependencies regarding utilities and commerce. Implementing mechanisms for these actions include land use regulations, development and redevelopment policies, floodproofing, disaster preparedness and response plans, and flood forecasting and warning systems.

Different tools may be more suitable for developed or underdeveloped flood plains or for urban or rural areas. The information contained in this report is particularly useful for the preparation of flood plain regulations.

a. Flood Plain Regulations.

Flood plain regulations apply to the full range of ordinances and other means designed to control land use and construction within floodprone areas. The term encompasses zoning ordinances, subdivision regulations, building and housing codes, encroachment line statutes, open area regulations, and other similar methods of management which affect the use an' development of floodprone areas.

Flood plain land use management does not prohibit use of floodprone areas; to the contrary, flood plain land use management seeks the best use of flood plain lands. The flooded area map and the water surface profile contained in this report can be used to guide development in the flood plain. The elevations shown on the profile should be used to determine flood heights because they are more accurate than the outlines of flooded areas. It is recommended that development in areas susceptible to frequent flooding adhere to the principles expressed in Executive Order 11988 - Flood Plain Management, whose objective is to ". . . avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of flood plains . . . whenever there is a practicable alternative." Accordingly, development in areas susceptible to frequent flooding should consist of construction which has a low damage potential such as parking areas and golf courses. High value construction such as buildings, should be located outside the flood plain to the fullest extent possible.

In instances where no practicable alternative exists, the land should be elevated to minimize damages. If it is uneconomical to elevate the land in these areas, means of floodproofing the structure should be given careful consideration.

b. Development Zones.

A flood plain consists of two zones. The first zone is the designated "floodway" or that cross sectional area required for carrying or discharging the anticipated flood waters with a maximum 1-foot increase in flood level (Ohio Department of Natural Resources standard). Velocities are the greatest and most damaging in the floodway. Regulations essentially maintain the flow-conveying capability of the floodway to minimize inundation of additional adjacent areas. Uses which are acceptable for floodways include parks, parking areas, open spaces, etc.

The second zone of the flood plain is termed the "floodway fringe" or restrictive zone, in which inundation might occur but where depths and velocities are generally low. Although not recommended if practicable alternatives exist, such areas can be developed provided structures are placed high enough or floodproofed to be reasonably free from flood damage during the 100-year flood. Typical relationships between the floodway and floodway fringe are shown in Figure 2. The floodways for French Creek, Mills Creek, and Robinson Ditch have been plotted on the Flooded Area Maps, Plates 4 and 5.

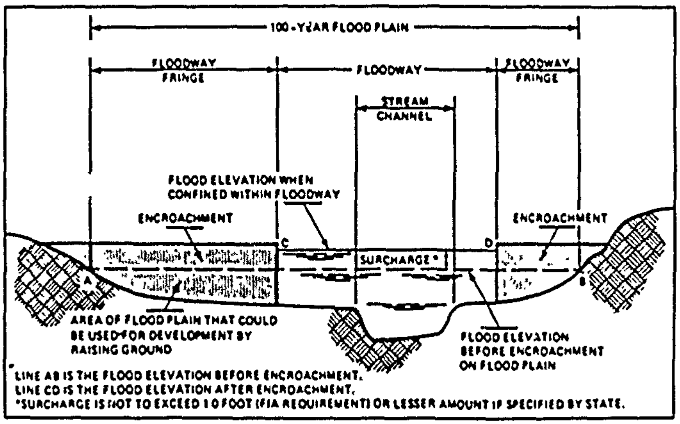

Figure 2 - Floodway Schematic

c. Formulation of Flood Plain Regulations.

Formulation of flood plain regulations in a simplified sense involves selecting the type and degree of control to be exercised for each specific flood plain. In principle, the form of the regulations is not as important as a maintained adequacy of control. The degree of control normally varies with the flood hazard as measured by depth of inundation, velocity of flow, frequency of flooding, and the need for available land. Considerable planning and research is required for the proper formulation of flood plain regulations. Formulation of flood plain regulations may require a lengthy period of time during which development is likely to occur. In such cases, temporary regulations should be adopted and amended later as necessary.

Modify Flooding

The traditional strategy of modifying floods through the construction of dams, dikes, levees and floodwalls, channel alterations, high flow diversions and spillways, and land treatment measures has repeatedly demonstrated its effectiveness for protecting property and saving lives, and it will continue to be a strategy of flood plain management. However, in the future, reliance solely upon a flood modification strategy is neither possible nor desirable. Although the large capital investment required by flood modifying tools has been provided largely by the Federal Government, sufficient funds from Federal sources have not been and are not likely to be available to meet all situations for which flood modifying measures would be both effective and economically feasible. Another consideration is that the cost of maintaining and operating flood control structures falls upon local governments.

Flood modifications acting alone leave a residual flood loss potential and can encourage an unwarranted sense of security leading to inappropriate use of lands in the areas that are directly protected or in adjacent areas. For this reason, measures to modify possible floods should usually be accompanied by measures to modify the susceptibility to flood damage, particularly by land use regulations.

Modify the Impact of Flooding on Individuals and the Community

A third strategy for mitigating flood losses consists of actions designed to assist individuals and communities in their preparatory, survival, and recovery responses to floods. Tools include information dissemination and education, arrangements for spreading the costs of the loss over time, purposeful transfer of some of the individual's loss to the community by reducing taxes in flood prone areas, and the purchase of Federally subsidized flood insurance.

The distinction between a reasonable and unreasonable transfer of costs from the individual to the community can also be regulated and is a key to effective flood plain management.

CONCLUSION

This report presents local flood hazard information for French Creek, Mills Creek, and Robinson Ditch in the city of North Ridgeville, Ohio. The U.S. Army Corps of Engineers, Buffalo District, will provide interpretation in the application of the data contained in this report, particularly as to its use in developing effective flood plain regulations. Requests should be coordinated with the Ohio Department of Natural Resources.

GLOSSARY

BACKWATER	The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.
BASE FLOOD	A flood which has an average return interval in the order of once in 100 years, although the flood may occur in any year. It is based on statistical analysis of streamflow records available for the watershed and analysis of rainfall and runoff characteristics in the general region of the watershed. It is commonly referred to as the "100-year flood."
DISCHARGE	The quantity of flow in a stream at any given time, usually measured in cubic feet per second (cfs).
FLOOD	An overflow of lands not normally covered by water. Floods have two essential characteristics: the inundation of land is temporary and the lands are adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water. Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, and rise of groundwater coincident with increased streamflow.
FLOOD CREST	The maximum stage or elevation reached by floodwaters at a given location.
FLOOD FREQUENCY	A statistical expression of the percent chance of exceeding a discharge of a given magnitude in any given year. For example, a <u>100-year flood</u> has a magnitude expected to be exceeded on the average of once every hundred years. Such a <u>flood</u> has a 1 percent chance of being exceeded in any given year. Often used interchangeably with <u>RECURRENCE INTERVAL</u>.

FLOOD PLAIN	The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water that have been or may be covered by floodwater.
FLOOD PROFILE	A graph showing the relationship of water surface elevation to location; the latter generally expressed as distance upstream from a known point along the approximate centerline of a stream of water that flows in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.
FLOOD STAGE	The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.
FLOODWAY	The channel of a watercourse and those portions of the adjoining flood plain required to provide for the passage of the selected flood (normally the 100-year flood) with an insignificant increase in the flood levels above that of natural conditions. As used in the National Flood Insurance Program, floodways must be large enough to pass the 100-year flood without causing an increase in elevation of more than a specified amount (1 foot in most areas).
RECURRENCE INTERVAL	A statistical expression of the average time between floods exceeding a given magnitude (see FLOOD FREQUENCY).

REFERENCES

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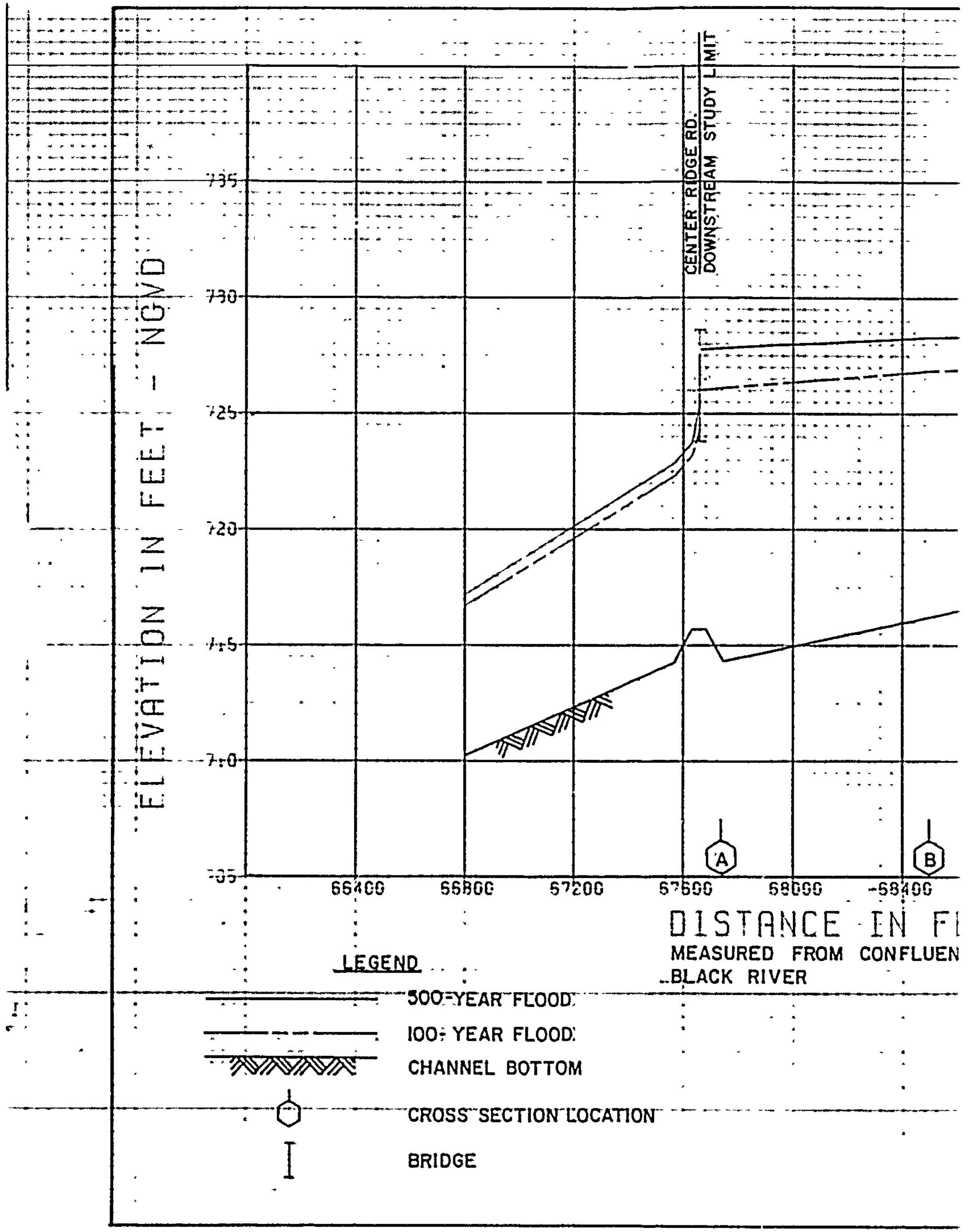
3. U.S. Geological Survey, Water Resources Investigation Report 89-4126, Techniques for Estimating Flood-Peak Discharges of Rural, Unregulated Streams in Ohio, March 1990.

4. U.S. Soil Conservation Service, Technical Report 55, Urban Hydrology for Small Watersheds, 2nd Edition, June 1986.

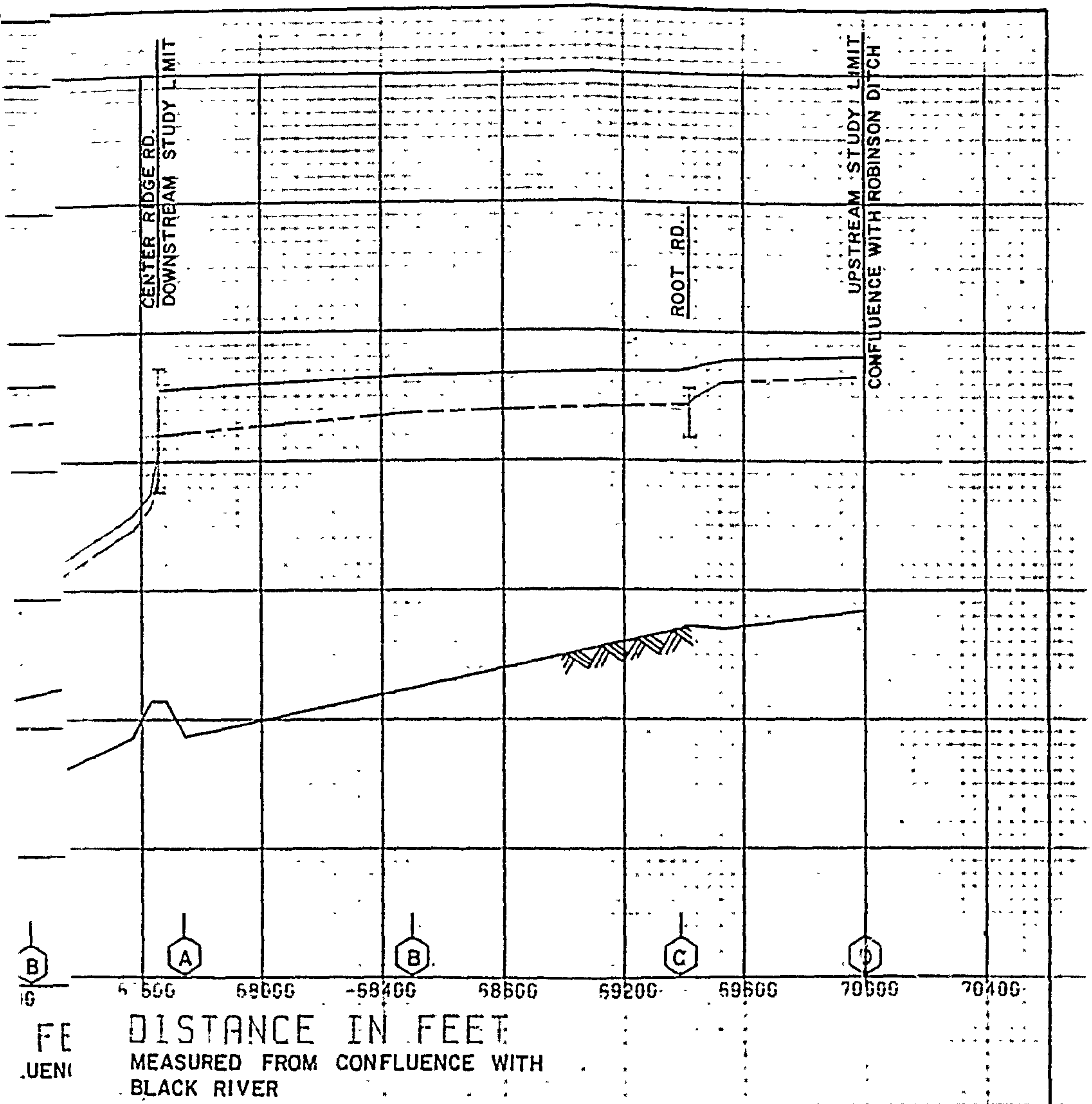
5. U.S. Department of the Interior, Geologic survey, 7.5 Minute Series Topographic Maps, Scale 1.24,000, Avon, Ohio, photo-revised 1979, Contour Interval 5 feet; North Olmsted, Ohio, photorevised 1985, Contour Interval 10 feet.

6. U.S. Geological Survey, National Handbook of Recommended Methods for Water Data Acquisition, 1977.

7. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles Generalized Computer Program, Davis, California, 1974.



ELEVATION IN FEET - NGVD
735
730
725
720
715
710
705
CENTER RIDGE RD.
DOWNSTREAM STUDY LIMIT
A
B
66400
66800
67200
67600
68000
68400
DISTANCE IN FE
MEASURED FROM CONFLUEN
BLACK RIVER
LEGEND
500-YEAR FLOOD
100- YEAR FLOOD
CHANNEL BOTTOM
CROSS SECTION LOCATION
BRIDGE



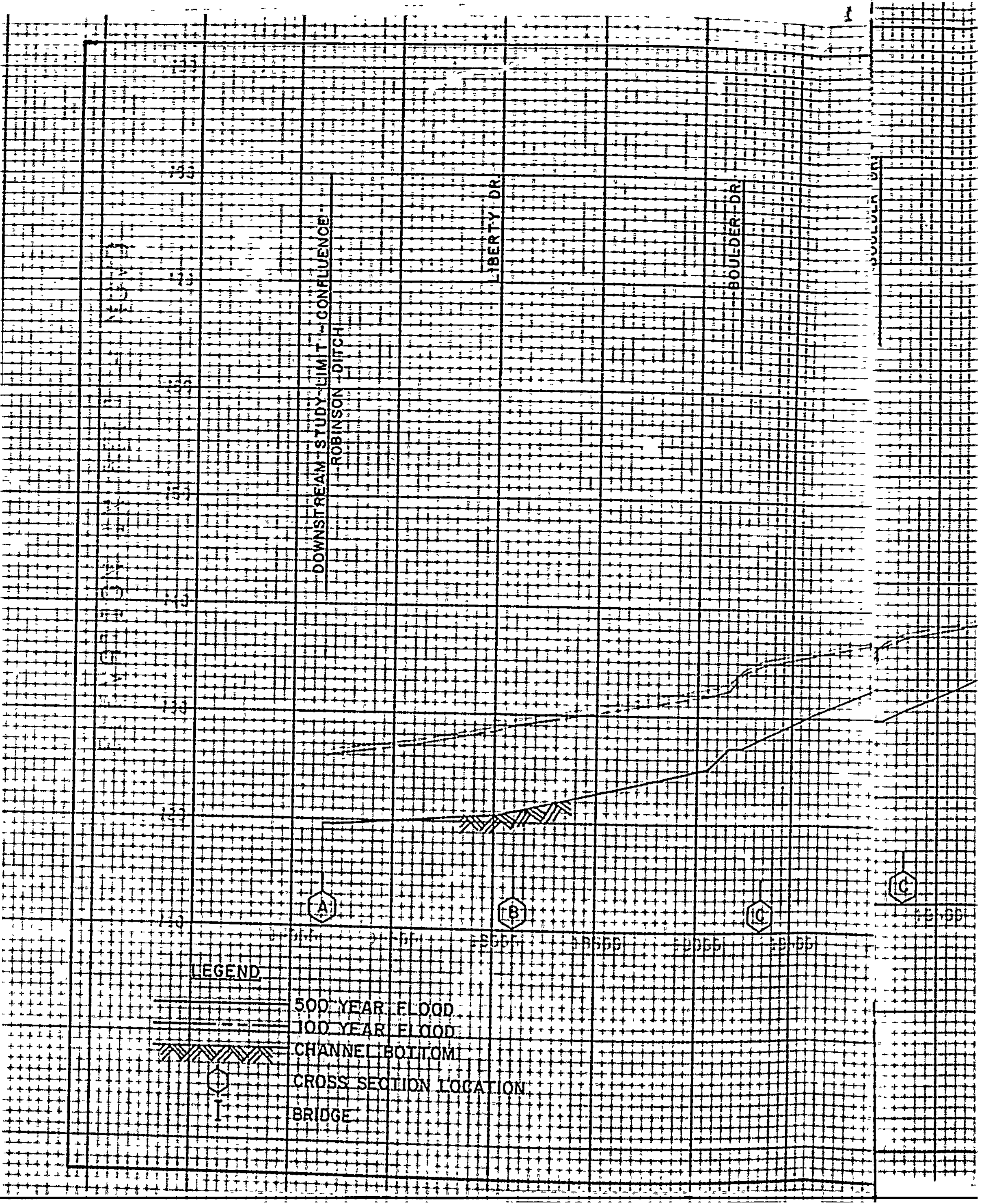
U.S. Army Engineer District, Buffalo
SPECIAL FLOOD HAZARD EVALUATION

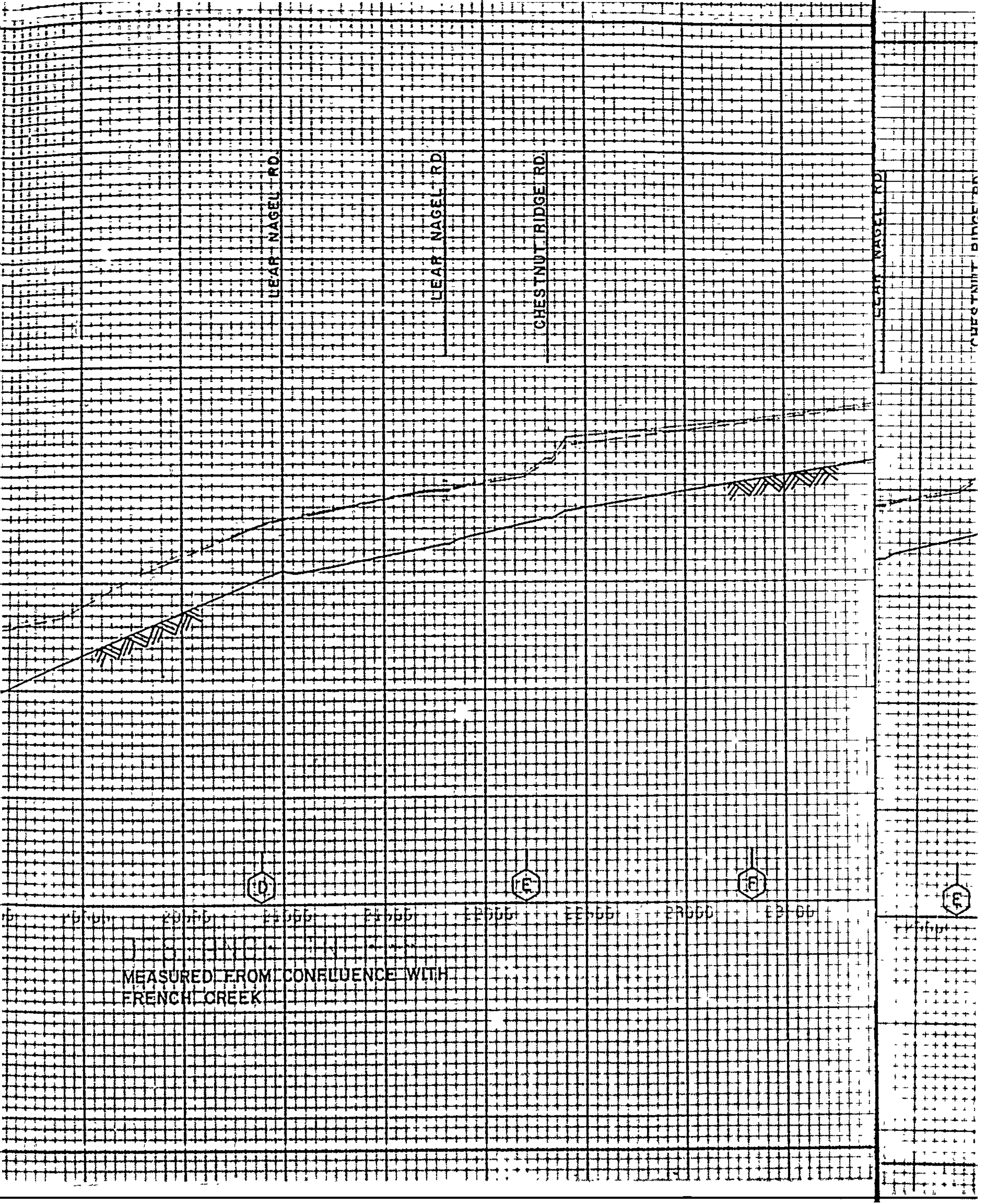
FLOOD PROFILE

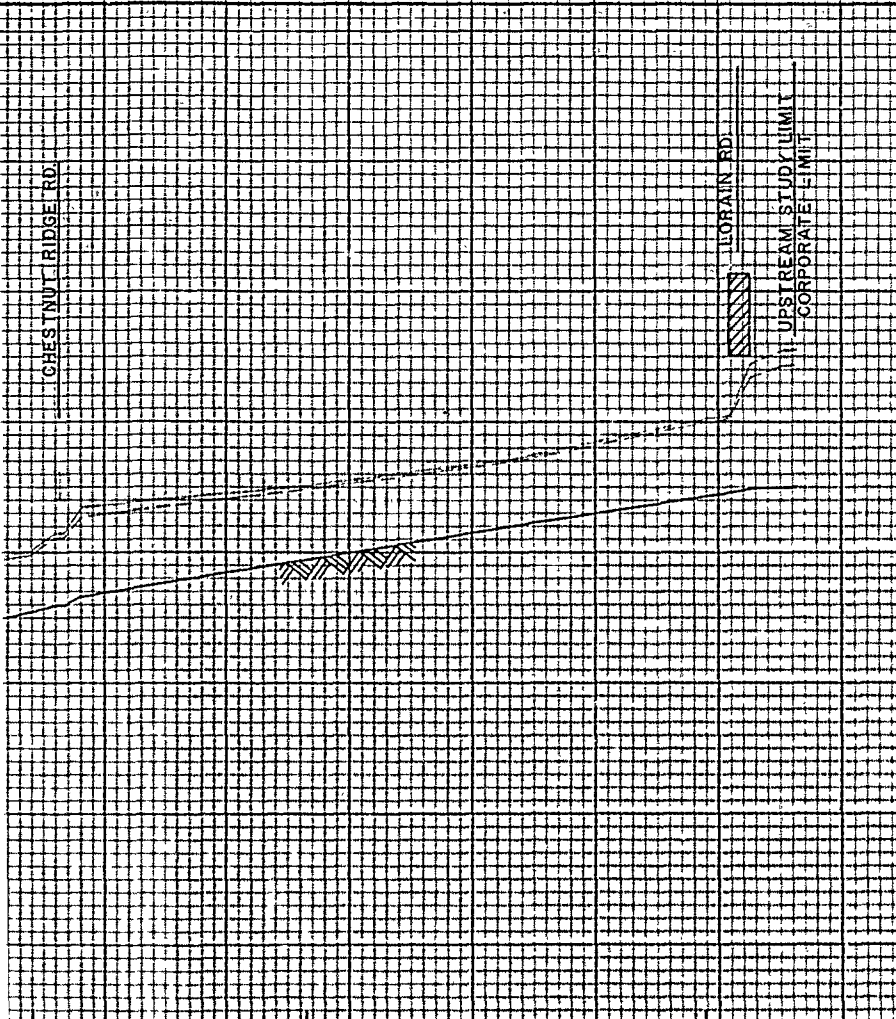
FRENCH CREEK

NORTH RIDGEVILLE, OHIO

PLATE 1 DEC. 1991


DOWNSTREAM STUDY LIMIT - CONFLUENCE
ROBINSON DITCH
LIBERTY DR.
BOULDER DR.
A
B
C
C
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
CHANNEL BOTTOM
CROSS SECTION LOCATION
BRIDGE


LEAR NAGEL RD.
LEAR NAGEL RD.
CHESTNUT RIDGE RD.
LEAR NAGEL RD.
D
E
MEASURED FROM CONFLUENCE WITH
FRENCH CREEK

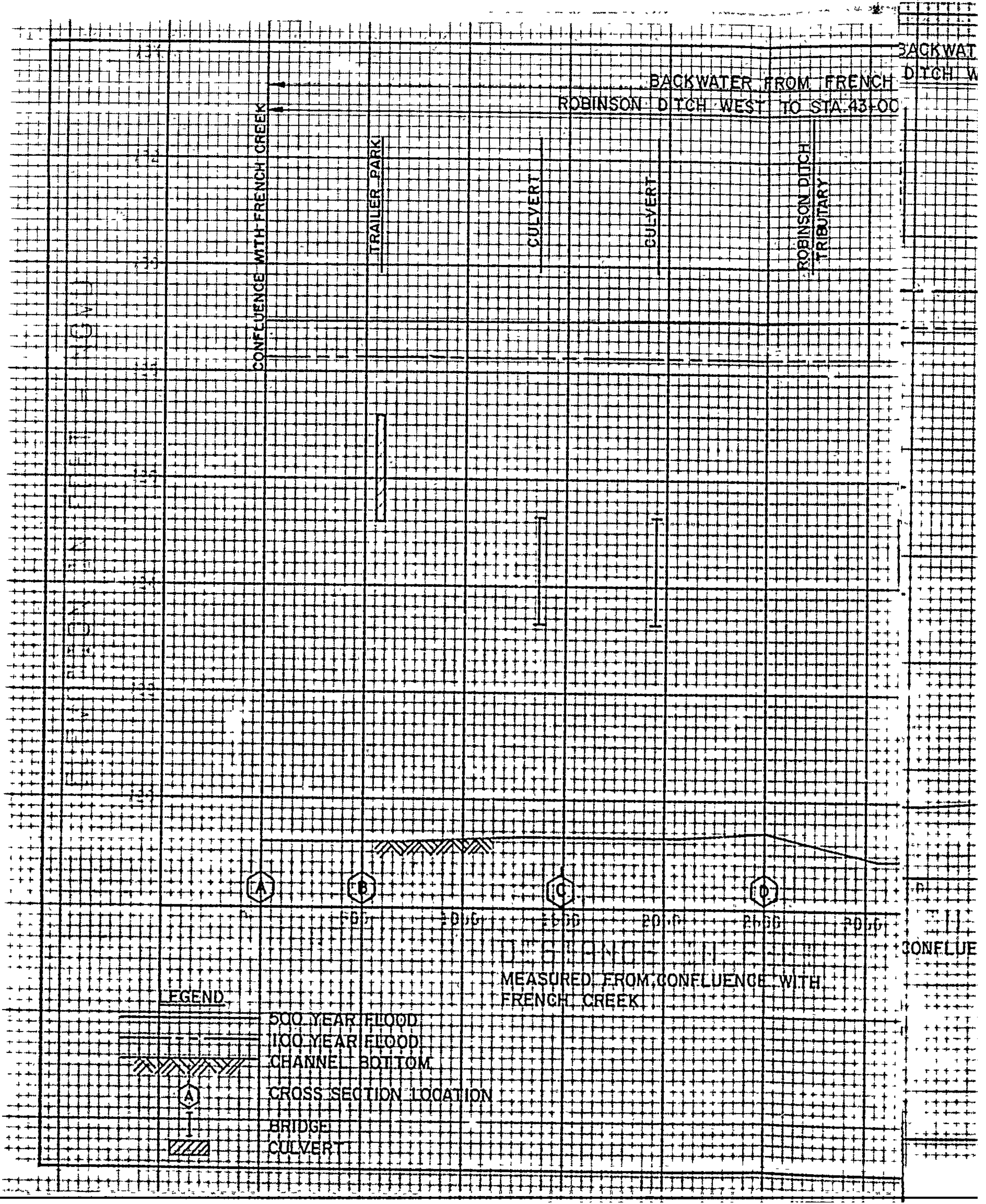


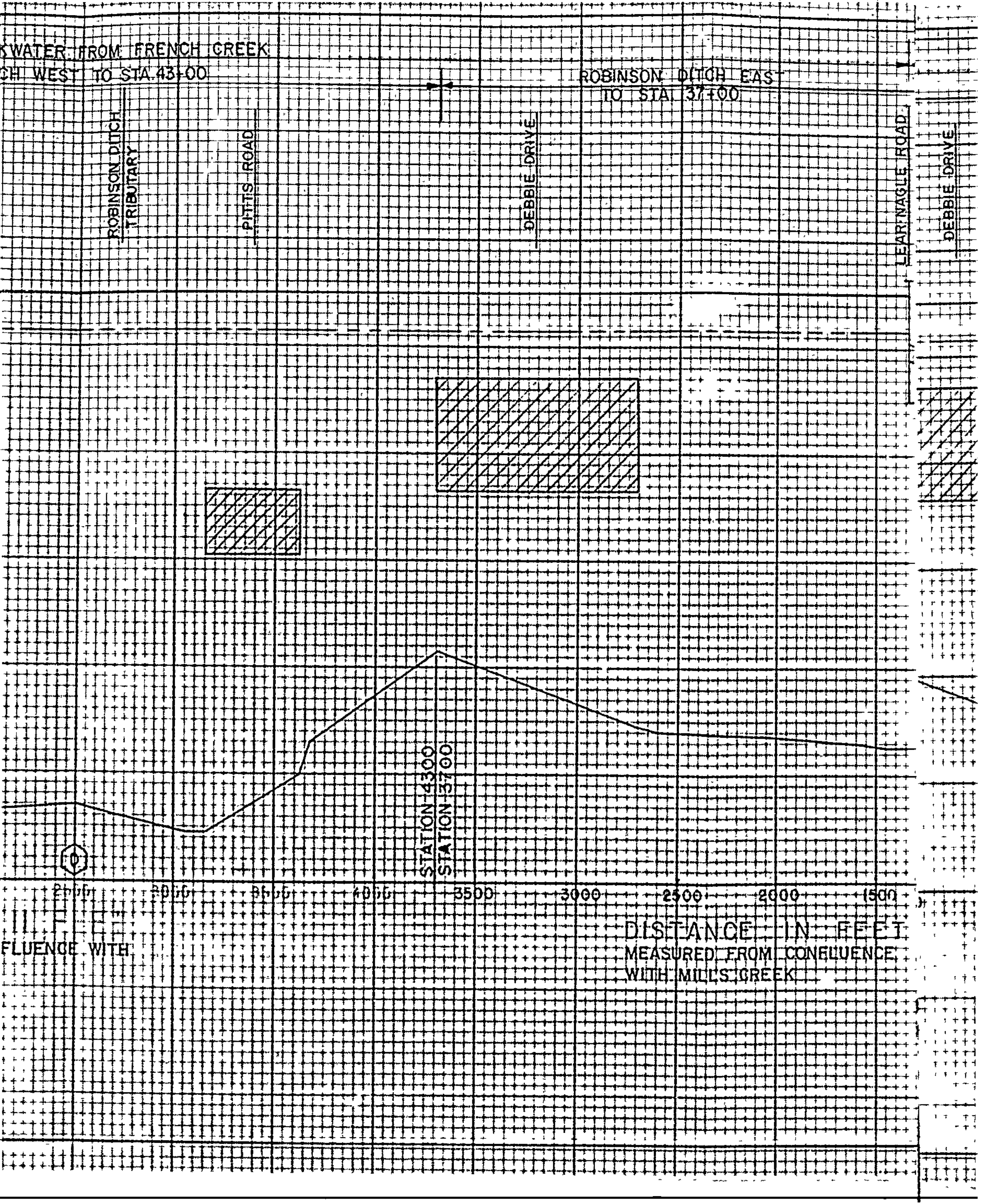
U.S. Army Engineer District, Buffalo
SPECIAL FLOOD HAZARD EVALUATION

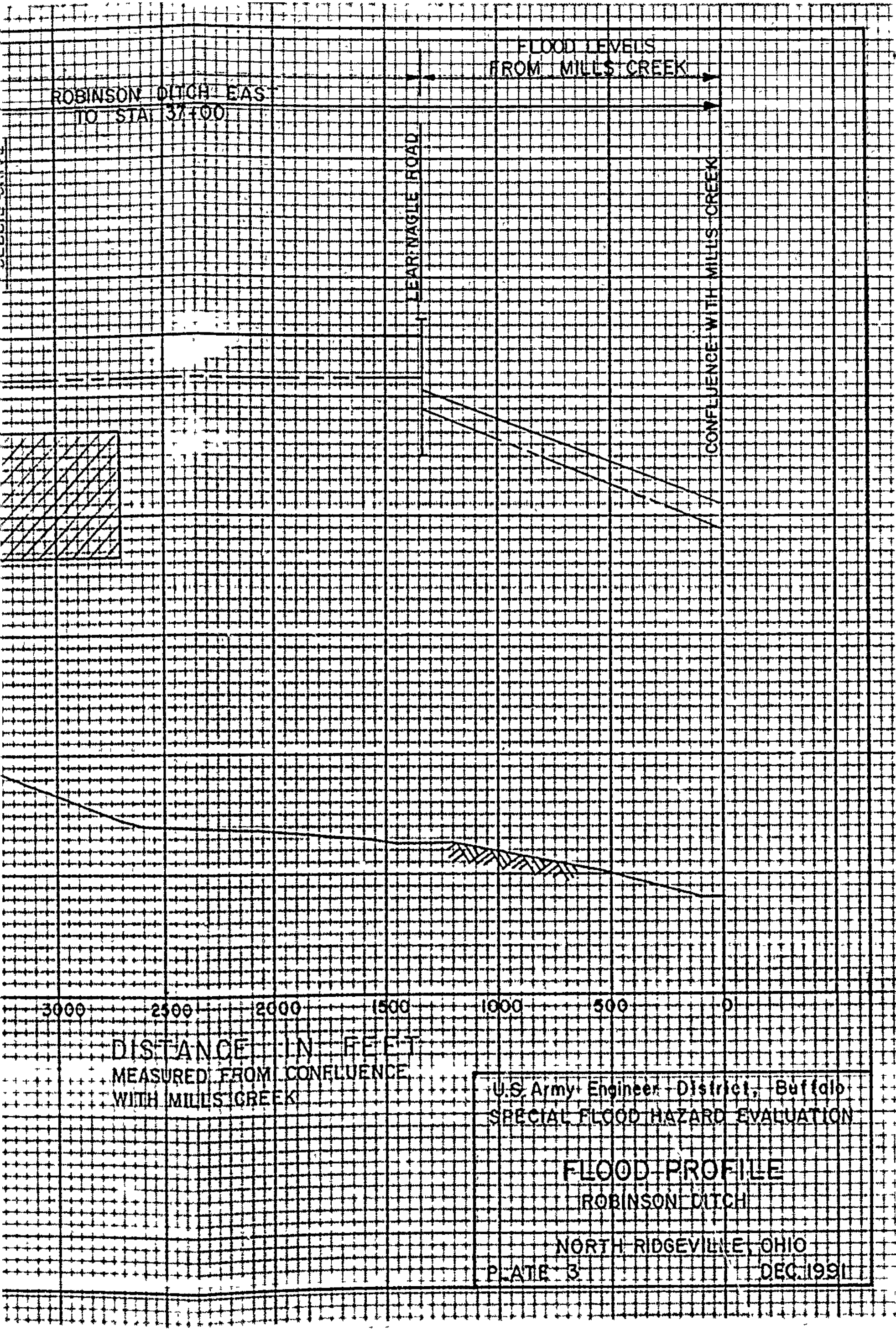
FLOOD PROFILE
MILLS CREEK

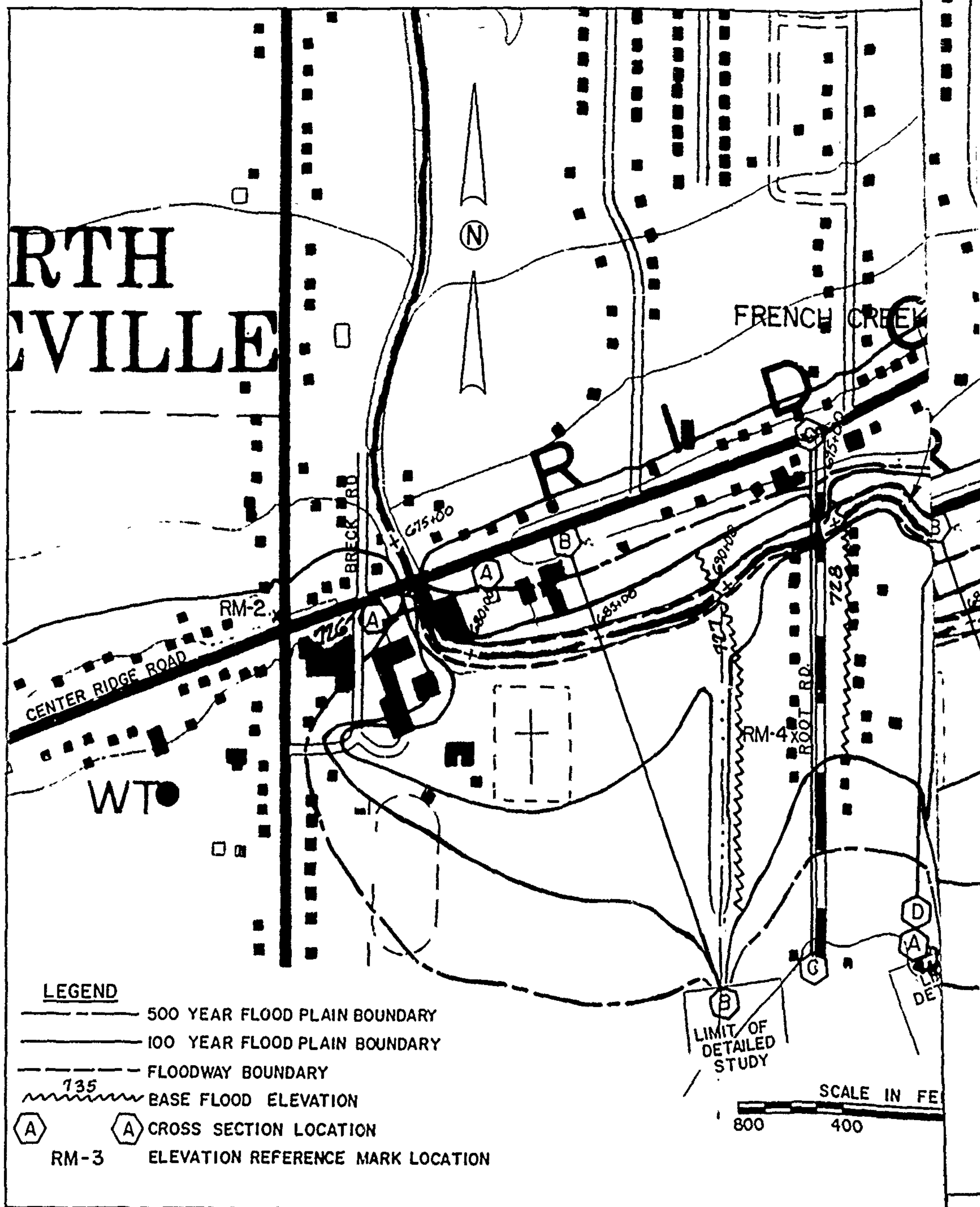
NORTH RIDGEVILLE, OHIO

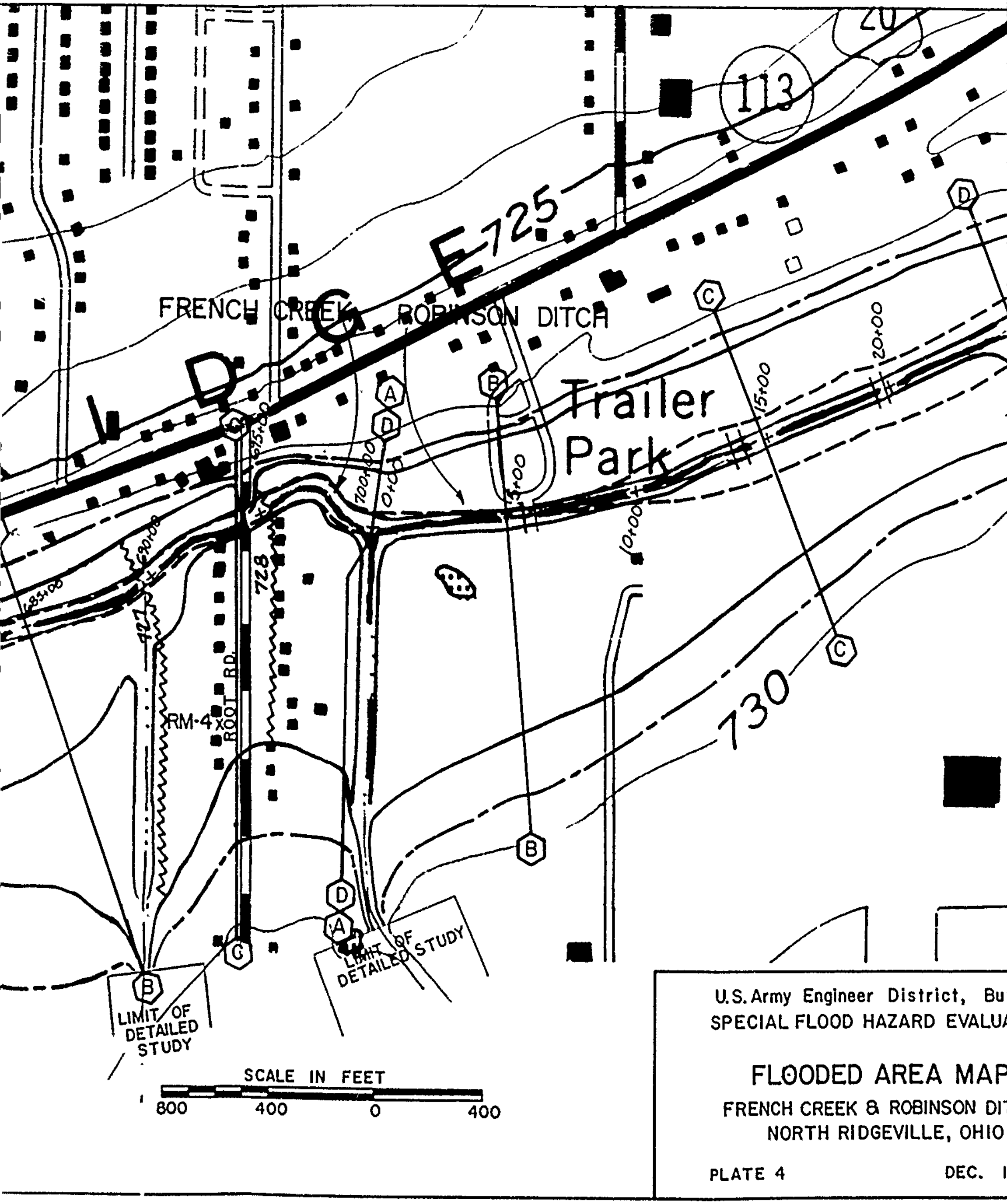
PLATE 2 DEC 1991


BACKWATER FROM FRENCH
ROBINSON DITCH WEST TO STA.43+00
CONFLUENCE WITH FRENCH CREEK
TRAILER PARK
CULVERT
CULVERT
ROBINSON DITCH
TRIBUTARY
A
B
C
D
MEASURED FROM CONFLUENCE WITH
FRENCH CREEK
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
CHANNEL BOTTOM
CROSS SECTION LOCATION
BRIDGE
CULVERT

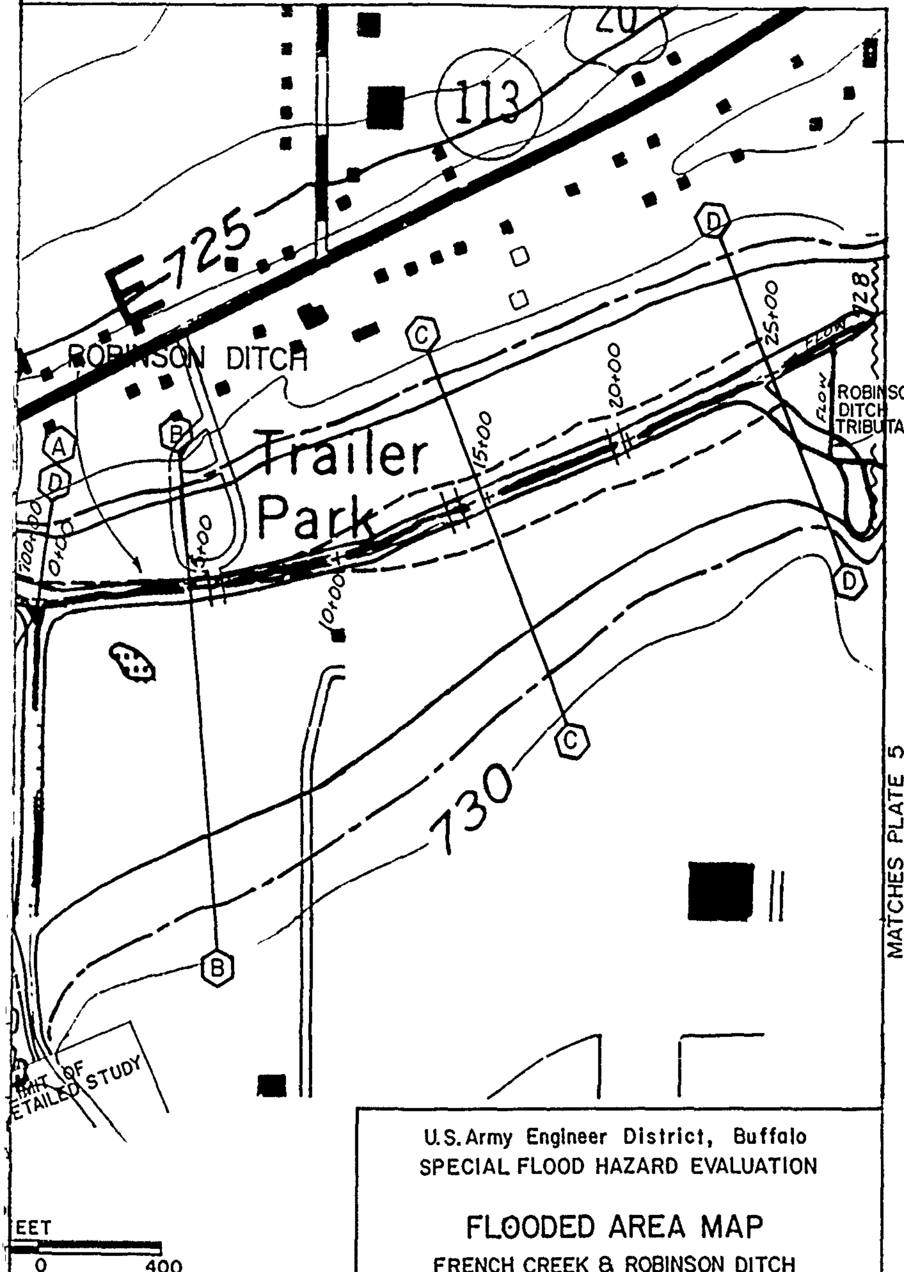

KWATER FROM FRENCH CREEK
CH WEST TO STA.43+00
ROBINSON DITCH EAS
TO STA. 37+00
ROBINSON DITCH TRIBUTARY
PITTS ROAD
DEBBIE DRIVE
LEARNAGLE ROAD
DEBBIE DRIVE
STATION 4300
STATION 3700
3500
3000
2500
2000
1500
FLUENCE WITH
DISTANCE IN FEET
MEASURED FROM CONFLUENCE WITH MILLS CREEK


FLOOD LEVELS
FROM MILLS CREEK
ROBINSON DITCH EAS
TO STA 37+00
LEAR NAGLE ROAD
CONFLUENCE WITH MILLS CREEK
3000
2500
2000
1500
1000
500
0
DISTANCE IN FEET
MEASURED FROM CONFLUENCE
WITH MILLS CREEK
U.S. Army Engineer District, Buffalo
SPECIAL FLOOD HAZARD EVALUATION
FLOOD PROFILE
ROBINSON DITCH
NORTH RIDGEVILLE, OHIO
PLATE 3
DEC 1991


RTH
VILLE
FRENCH CREEK
CENTER RIDGE ROAD
BRECK RD.
ROOT RD.
RM-2
RM-4
WT
N
675+00
680+00
685+00
690+00
695+00
726
727
728
A
B
C
D
LIMIT OF DETAILED STUDY
SCALE IN FE
800
400
LEGEND
500 YEAR FLOOD PLAIN BOUNDARY
100 YEAR FLOOD PLAIN BOUNDARY
FLOODWAY BOUNDARY
735 BASE FLOOD ELEVATION
A A CROSS SECTION LOCATION
RM-3 ELEVATION REFERENCE MARK LOCATION



113
725
FRENCH CREEK
ROBINSON DITCH
Trailer Park
730
728
727
RM-4
ROOT RD.
A
B
C
D
15+00
20+00
10+00
5+00
0+00
100+00
615+00
690+00
685+00
LIMIT OF DETAILED STUDY
LIMIT OF DETAILED STUDY
LIMIT OF DETAILED STUDY
SCALE IN FEET
800
400
0
400
U.S. Army Engineer District, Bu
SPECIAL FLOOD HAZARD EVALUA
FLOODED AREA MAP
FRENCH CREEK & ROBINSON DI
NORTH RIDGEVILLE, OHIO
PLATE 4
DEC. 1



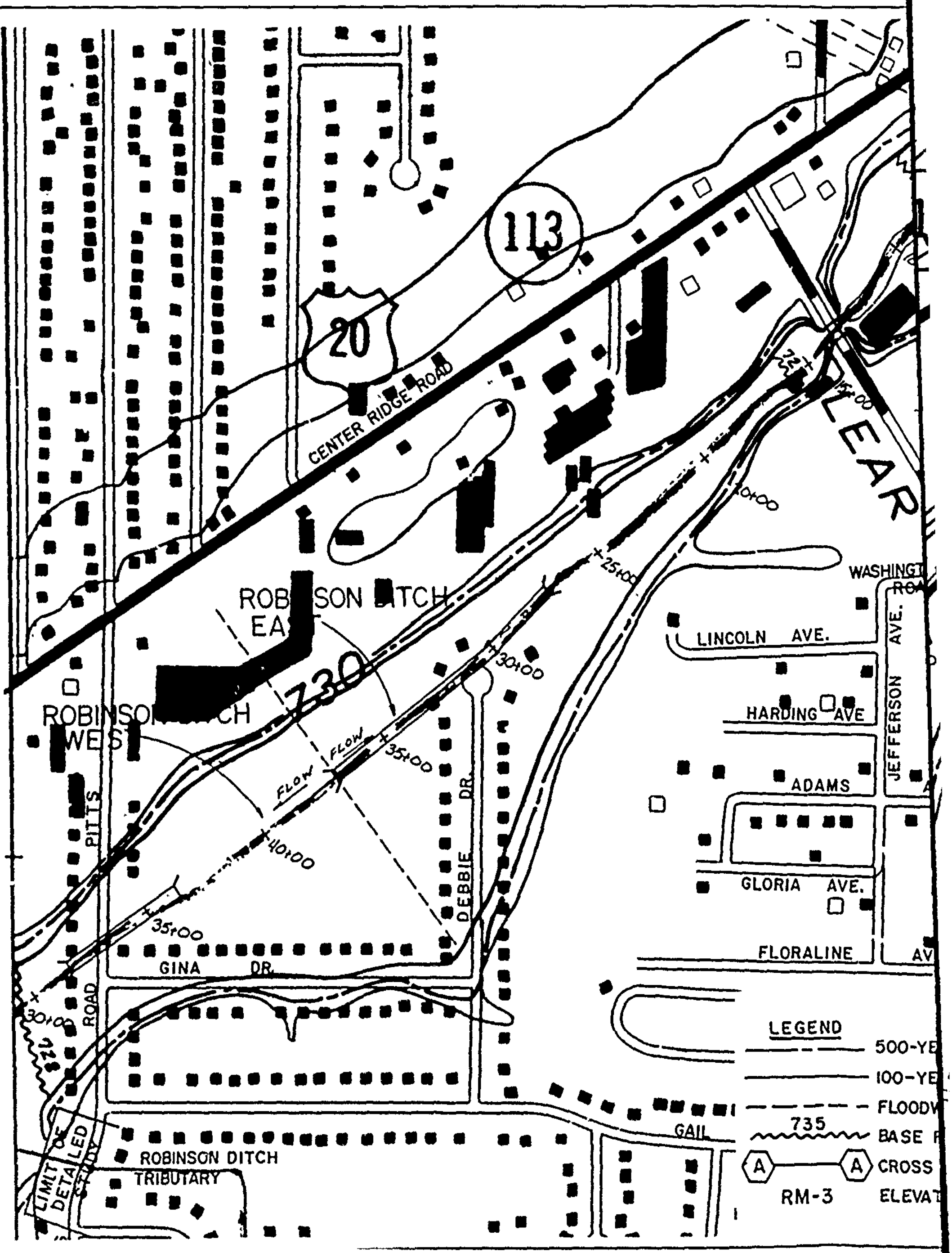
U.S. Army Engineer District, Buffalo
SPECIAL FLOOD HAZARD EVALUATION

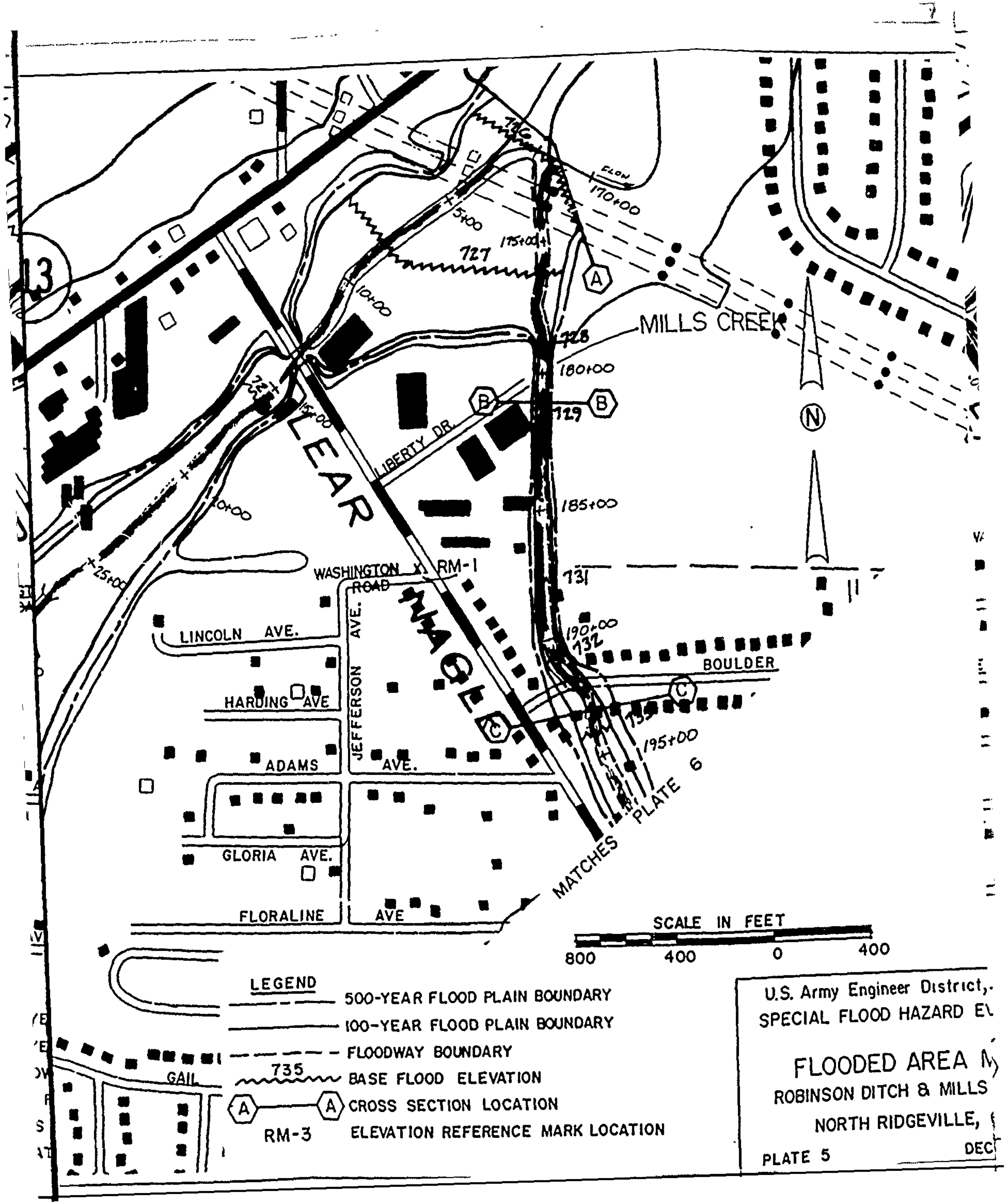
FLOODED AREA MAP

FRENCH CREEK & ROBINSON DITCH
NORTH RIDGEVILLE, OHIO

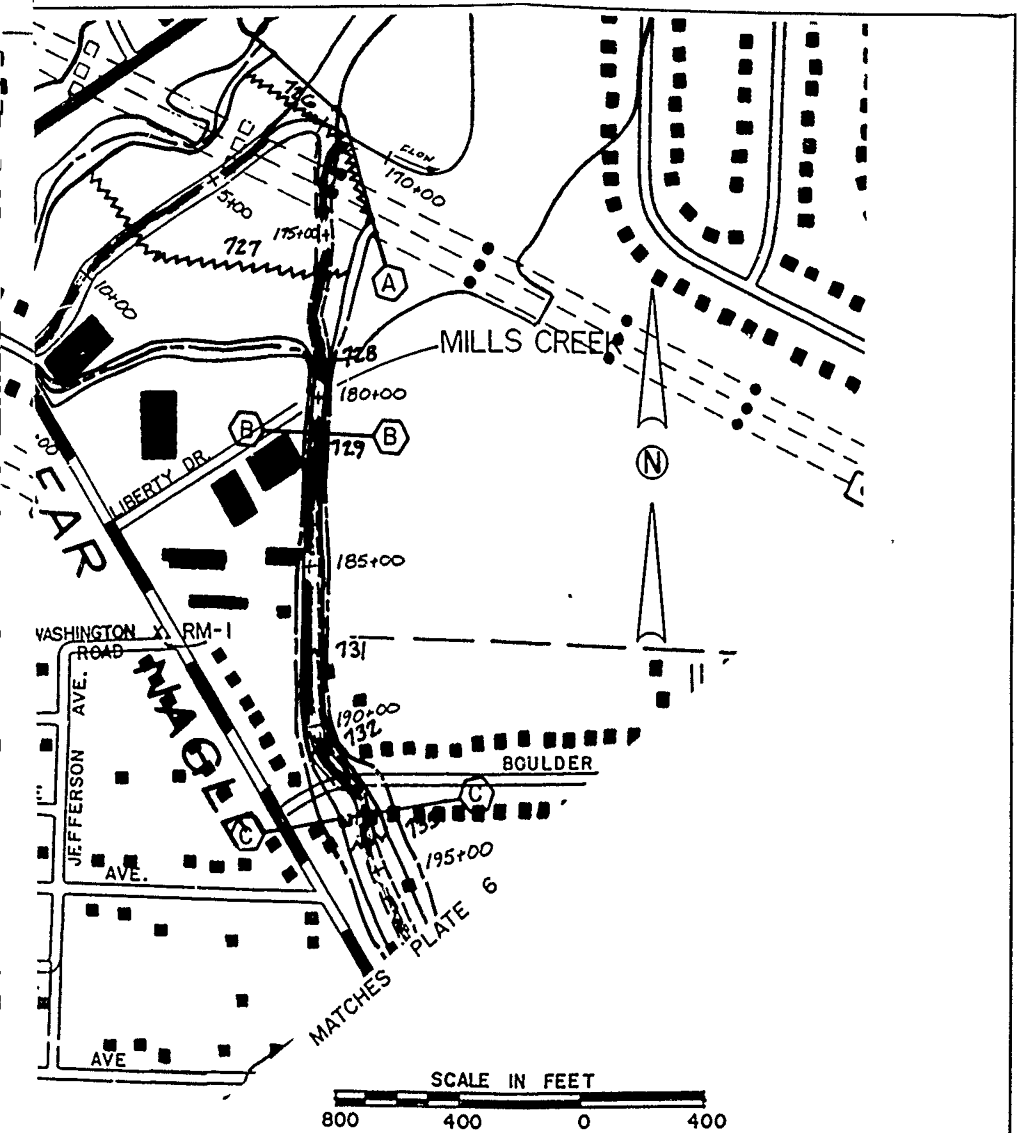
PLATE 4 DEC. 1991

MATCHES PLATE 4





13
MILLS CREEK
FLOW
726
727
728
729
731
732
733
5+00
10+00
15+00
20+00
25+00
170+00
175+00
180+00
185+00
190+00
195+00
A
B
C
N
LIBERTY DR.
LEAR
NAGEL
WASHINGTON ROAD
RM-1
LINCOLN AVE.
HARDING AVE
JEFFERSON AVE.
ADAMS AVE.
GLORIA AVE.
FLORALINE AVE
BOULDER
GAIL
MATCHES PLATE 6
SCALE IN FEET
800 400 0 400
LEGEND
500-YEAR FLOOD PLAIN BOUNDARY
100-YEAR FLOOD PLAIN BOUNDARY
FLOODWAY BOUNDARY
735 BASE FLOOD ELEVATION
CROSS SECTION LOCATION
RM-3 ELEVATION REFERENCE MARK LOCATION
U.S. Army Engineer District,
SPECIAL FLOOD HAZARD E
FLOODED AREA M
ROBINSON DITCH & MILLS
NORTH RIDGEVILLE,
PLATE 5
DEC



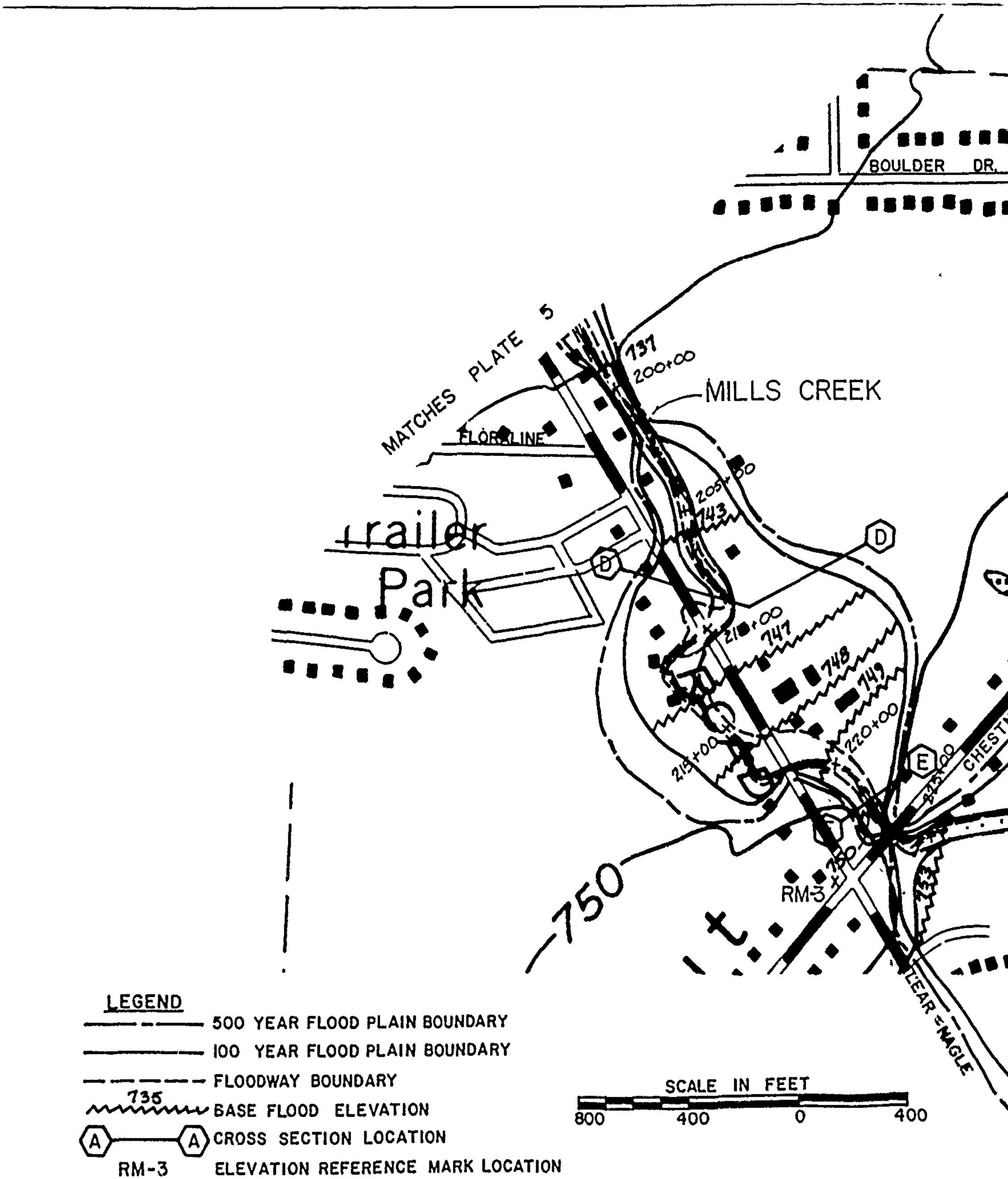
500-YEAR FLOOD PLAIN BOUNDARY
100-YEAR FLOOD PLAIN BOUNDARY
FLOODWAY BOUNDARY
BASE FLOOD ELEVATION
CROSS SECTION LOCATION
ELEVATION REFERENCE MARK LOCATION

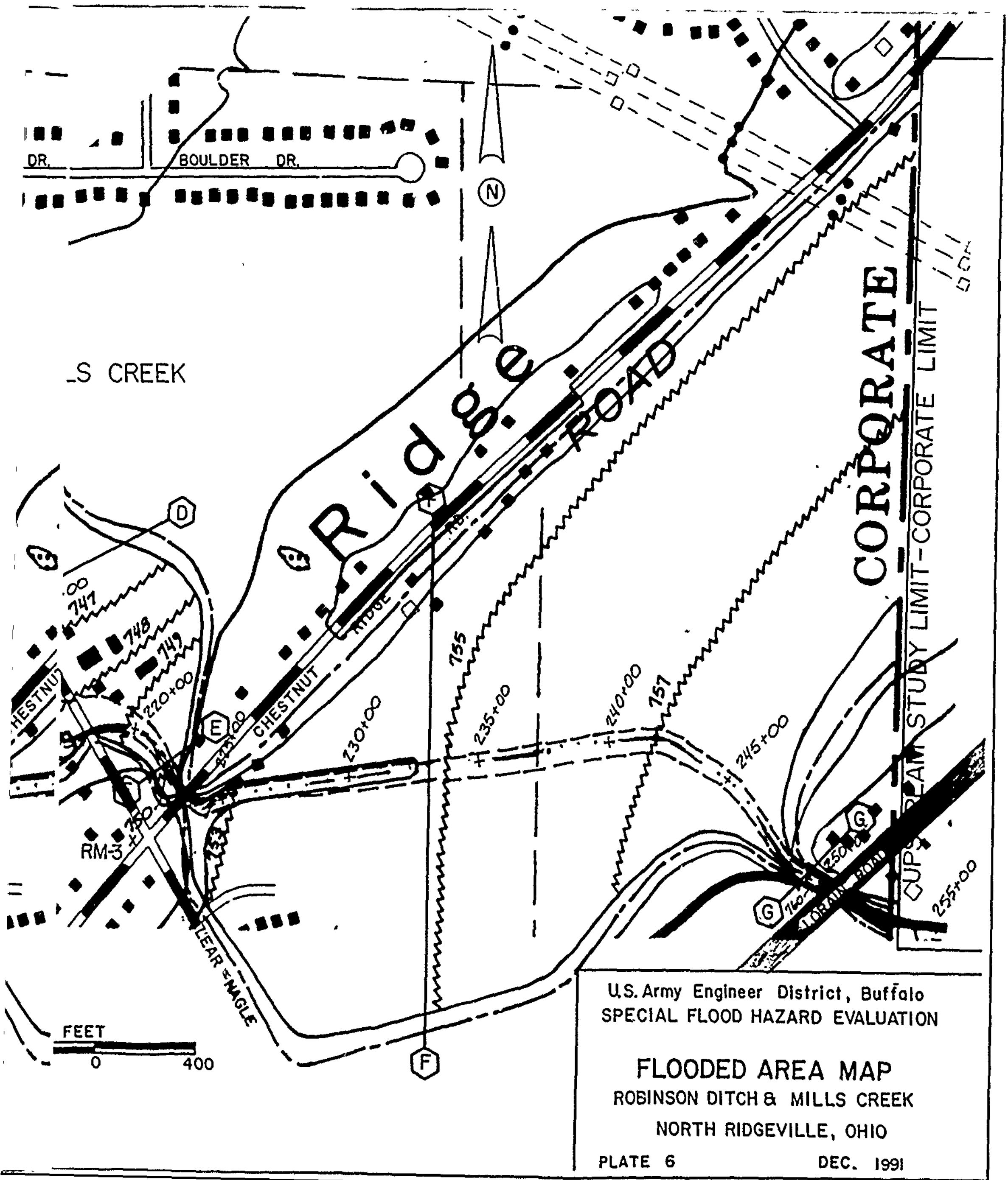
U.S. Army Engineer District, Buffalo
SPECIAL FLOOD HAZARD EVALUATION

FLOODED AREA MAP

ROBINSON DITCH & MILLS CREEK
NORTH RIDGEVILLE, OHIO

PLATE 5 DEC. 1991


BOULDER DR.
MATCHES PLATE 5
737
200+00
MILLS CREEK
205+50
743
D
D
railer
Park
210+00
747
748
749
215+00
220+00
E
225+00
CHESTN
750
RM-3
LEAR NAGLE
LEGEND
500 YEAR FLOOD PLAIN BOUNDARY
100 YEAR FLOOD PLAIN BOUNDARY
FLOODWAY BOUNDARY
735
BASE FLOOD ELEVATION
A
A
CROSS SECTION LOCATION
RM-3
ELEVATION REFERENCE MARK LOCATION
SCALE IN FEET
800
400
0
400



U.S. Army Engineer District, Buffalo
SPECIAL FLOOD HAZARD EVALUATION

FLOODED AREA MAP
ROBINSON DITCH & MILLS CREEK
NORTH RIDGEVILLE, OHIO

PLATE 6 DEC. 1991